Food Waste Composting Demonstration Project
University of Montana – Dining Services

PROJECT REPORT

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1.0 INTRODUCTION

The University of Montana (UM) is conducting a food waste composting demonstration project. The objectives of the project are to reduce landfilling, establish the costs and benefits of on-campus food waste composting, explore the use of various bulking agents and different compost recipes, provide opportunities for compost- and composting-related education and research, and help evaluate whether or not a large-scale campus-wide or campus-community composting project might be worth pursuing.

The purpose of this report is to document the demonstration project and provide information that could help others learn from this experience. The report presents information describing project initiation, project equipment and operations, initial experiences including lessons learned, outreach activities, and future plans.

1.1 History

The food waste composting demonstration project described in this report is not the first food waste composting project on the University of Montana campus. The University initiated their first food waste composting project in 1999. The objectives of that project were to reduce landfilling by making compost out of University food wastes, then to use the compost on the University-associated PEAS farm which grows fresh organic vegetables for the local food bank. Under this program, food wastes were separated into special containers the University's main kitchen, then the containers were picked up by student volunteers twice a week and trucked to the PEAS Farm where the waste was spread out over windrows and covered with manure and straw. PEAS personnel turned the piles and used the finished compost to grow their organic produce. This system worked well until the collection of food waste containers was reduced to once per week, which resulted in food waste sitting around on campus for several days at a time, which in turn created odor problems. Eventually, untrained student volunteers began dumping food waste at the farm without spreading and covering it, creating yet more odors and an unmanageable mess for PEAS personnel. Complaints at both ends led to the program's demise.

2.0 CURRENT PROJECT INITIATION

In the fall of 2002, Josh Burnim, the UM recycling program student intern at the time, presented a proposal to the UM recycling committee to initiate a new project to compost Dining Services food preparation scraps, and eventually post-consumer food waste, in order to help achieve campus-wide waste reduction goals. To help further this proposal, Josh sought advice from various professors on campus and from Denise DeLuca, a private engineering consultant with experience in composting. Denise worked with Josh and others to glean lessons learned from the first campus composting project, collect food waste generation data, develop necessary collaborative relationships, and identify potential composting technology options.

2.1 Lessons Learned from First Project

The first compost project was abandoned, but many of the elements of that project were deemed successful. Below is a list of lessons learned from the first project that was used in development of the current project.

- Separation of food wastes in campus kitchens can be done successfully.
- Food waste generates offensive odors quickly and needs to be processed within 24 hours.
- Food waste composting is a form of solid waste management and as such must be handled as part of Facility Services waste management infrastructure.
- Collaboration and coordination between Dining Service and Facility Services is required for project success
- Paid University staff must be responsible for all aspects of the composting operation, from food waste separation through compost end-use. Student volunteers should not solely responsible for key operations.
- Composting on campus (rather than off campus) eliminates the need to haul food wastes and provides on-campus opportunities for education and research
- On-campus composting requires the use of an in-vessel system equipped with a built-in odor control system

2.2 Food Waste Generation Data

It was determined that budget and personnel limitations precluded conducting a thorough waste audit. It was also determined that since the proposed composting system would be backed-up by the existing traditional waste collection system, it was not necessary to have accurate food waste generation data to develop the proposed compost demonstration project. For these reasons, the project was developed using limited readily available historical food waste generation data.

Historical food waste generation data indicated that the Food Zoo (the main cafeteria on campus) generated 9 tons of pre-consumer and 15 tons of post-consumer waste during

1998. Data collected as part of a 5-day “weigh the wastes” event conducted at the Food Zoo in the fall of 2000 indicated that the facility generates about 200 lbs/day of post-consumer food waste. Interviews with Dining Services staff suggested that waste generation on Saturdays is about half that of every other day during the week. It was also learned that the facilities are closed over winter break (no waste generated), and that food service and waste generation vary week to week over the summer months.

Based on the information above, it was assumed that 120 lbs/day of pre-consumer food waste and 200 lbs/day of post-consumer food waste would be available for the compost demonstration project.

2.3 Collaborators

One of the lessons learned from the first composting project was that Dining Services, who generates the food waste, and Facility Services, who is responsible for campus solid waste management, would need to work together to make the project successful. In addition, since the new project was intended to demonstrate the multiple benefits of composting, University faculty were encouraged to participate by finding ways to incorporate the composting system and/or the finished compost into their research and teaching. Project collaborators included key personnel from Dining Services and Facilities Services, student intern(s) from the recycling program, two faculty members, various interested students, one private sector consultant, and a representative of the Montana Department of Environmental Quality Pollution Prevention program.

Project collaborators held several meetings to develop the proposed project, discuss the importance of cooperation, evaluate available information, select the composing technology and location, discuss permitting and funding issues, assign responsibilities, and initiate education and outreach projects.

2.4 Technology Selection

Project collaborators determined early in the process that composting should take place on campus using an in-vessel composting system equipped with an odor control mechanism. They also decided that the purpose of the project is to demonstrate the <u>benefits of food waste composting and compost use</u>, not to demonstrate a new method of composting. These benefits include reduced waste hauling, reduced landfilling, waste education, beneficial re-use of waste materials, and increase soil quality with compost applications. For this reason, it was decided that the new project would use a proven commercially available composting system.

Research into composting systems revealed that there are very few systems available that are of an appropriate size and that meet the desired criteria. Through process of elimination, the Earth Tub composting system manufactured by Green Mountain Technologies was determined to be the only apparently viable system available. Project collaborators conducted further research to determine how well this system has worked in other installations. It was determined that this system was not perfect, but the positives appeared to outweigh the negatives.

2.5 Permitting

Another lesson learned from the first composting program is that composting food wastes requires a permit or license from the Montana Department of Environmental Quality (DEQ), Solid Waste Permitting and Compliance section. Personnel from the DEQ were asked for guidance regarding the potential status of the proposed project relative to compost regulations. After several exchanges of information and a meeting, the DEQ determined that the proposed project would be a demonstration and education project and as such was exempt from permitting. At this point, the DEQ became a project collaborator and later helped secure grant funding.

2.6 Costs and Funding

2.6.1 Start-Up Costs

Start-up costs of the new compost system included purchasing the composting equipment, purchasing new food waste collection containers, preparing and modifying the site where the equipment would be located, installing the equipment, professional emptying and cleaning (after failure of the first batch), and retrofitting the system plumbing to correct the problem that caused the initial failure. Some of the site modifications were catalyzed by, but not directly related to, installation of the composting system. Additional untracked costs included the staff time required for administration, meetings, training, development of plans, etc. The estimated total cost of installing and establishing operation of the Earth Tub system was $40,132. Table 2.0 presents a list of project start-up costs.

Table 2.0 Food Waste Composting System Start-Up Costs

Cost Category	Cost
Site preparations and modifications	$19,727
2 Earth Tubs (with shipping)	$15,915
Equipment installation	$536
Emptying and cleaning tubs	$1,200
Plumbing retrofit	$1,066
Food waste collection containers	$143
Labor (approximate – not tracked)	$2,000
TOTAL	**$40,132**

2.6.2 Funding

The head of Dining Services (Mark LoParco) and the recycling committee (of which LoParco is a member) determined that a food waste composting program would ultimately provide multiple benefits to the University. With this in mind, LoParco was able to obtain funding from within the University to pay for the Earth Tubs, infrastructure modifications, and associated equipment costs. Facility Services agreed to provide staff for long-term operations and maintenance assistance to the project. The DEQ, Business and Community Assistance Program, was also able to obtain funding assistance from the EPA's Region 8 Pollution Prevention program. The EPA provided $5,000 towards the purchase of the Earth Tubs and another $4,723 toward an outreach and education program (grant administered by the Montana DEQ).

The objectives of the project included reducing the amount of material that the University sends to the landfill, and to reduce the amount of compost (or other soil amendments) that the University would need purchase for landscaping. Both of these objectives could result in costs savings the University; however, it was decided that these potential cost savings were not project drivers and would be calculated later if actually realized.

3.0 COMPOSTING EQUIPMENT AND PROCEDURES

3.1 Composting Equipment

The selected composting system is based on two Earth Tubs, manufactured by Green Mountain Technologies. Photos of the Earth Tubs used in the project are presented in the Appendix. The description of the Earth Tub system provided in the O&M manual is presented in the shaded area below (copied from the Green Mountain Technologies, Inc., Earth Tub O&M Manual, ©2000).

DESCRIPTION OF THE EARTH TUB™

The Earth Tub™ is a self-contained aeration and mixing system for composting food waste. The system operates as a continuous batch process where you add more material to each batch until the tub is full. The operation is similar to a home compost bin. The insulated vessel holds in the heat generated by composting to allow all-season composting.

System Components

The Earth Tub is comprised of four major components necessary for successful composting. The primary components are described in detail below.

Composting Vessel

The Earth Tub has a 3 cubic yard capacity and is made of durable MDPE plastic. The container, doors and lid are custom–molded double-wall construction and fully insulated with polyurethane foam. Each unit is equipped with two removable side doors for discharge of the compost product. The walls are sloped to aid in the unloading of the compost. The lid of the Earth Tub spins rotates to allow the eccentrically mounted auger to mix all portions of the compost.

Mixing Assembly

The Earth Tub contains a vertically mounted stainless steel auger attached to the rotating lid. The auger is powered by a 2 hp electric gear motor. The operator, pushing on the handles rotates the cover, which pushes the auger around the inside of the Earth Tub. The motor and auger are attached to a slide assembly that moves radially across the top of the cover. The slide can be positioned to mix the center or outer areas of the container by turning the hand crank on the cover. Two full rotations of the cover are required to mix the entire contents of the Earth Tub.

Aeration System

The forced aeration system is used to optimize the composting process. The effects are: minimized odor, maximized throughput and increased stability of the final product. Odors are minimized by supplying sufficient air to maintain an aerobic environment in the compost. This is achieved through the use of an electric blower. Exhaust gasses are drawn through the tub center post and are piped to the biofilter. As the exhaust gasses are drawn off to the biofilter unit, fresh air is pulled into the compost to provide the bacteria with the oxygen they require.

The floor of the container is perforated to allow air to be drawn into the bottom of the Earth Tub. Using a temperature reading from the compost mass, the operator may adjust a ball valve in the aeration lines to alter the flow of air accordingly. If the compost is too hot (above 140°F), the valve may be opened fully to maximize the draw of air through the compost. In general, the valve should remain opened slightly.

Biofilter

Biofilters are absorbent beds of porous organic materials containing microorganisms that break down odorous compounds. Smells generated in the Earth Tub compost unit are blown through the biofilter, which absorbs and degrades the odorous compounds. Biofilters are a popular odor control mechanism because: 1) they remove a broad spectrum of chemicals at various concentrations; 2) they tolerate neglect; 3) their media components, such as mature leaf compost, brush compost, and wood chips, are readily available; and 4) they are resilient in various environmental conditions, such as snow and rain. Their effectiveness quickly diminishes with drying out, however. Under average to best management, the filters are highly effective at removing odors and are fairly effective even under the worst management. The Earth Tub biofilter has been designed to require minimal maintenance, as described in the operations section.

3.2 Composting Procedures

Composting procedures were developed based on those recommended by the Earth Tub manufacturers in their O&M Manual (a general Earth Tub Operating Description can be found at http://www.gmt-organic.com/et-ops.html).

3.2.1 Compost Cycle

The Earth Tubs function as batch composting system. A composting cycle (one batch) is started by filling an empty tub half full (approximately 1.5 cubic yards) with wood chips, wood shavings, or some other appropriate carbon-rich bulking agent. This initial loading with wood shavings represents the total amount of bulking agent required for an entire compost cycle, though additional bulking agent can be added later if desired.

For the first composting cycle of the demonstration project, loads of wood shavings were obtained from the local Louisiana-Pacific plant. Other bulking agents that were considered, and that may be used in the future, include wood shavings or chips from the University's Lubrecht experimental forest, the Missoula County Fairgrounds (used animal bedding), and the Smurfit-Stone facility (local mill that produced Kraft paper for cardboard). Additional bulking agents under consideration are landscaping wastes (leaves, grass), and non-recyclable waste paper.

With the bulking agent in place, the established procedure is to load one tub with food waste every day for a week, then rest the first tub for a week while the second tub is loaded daily. This alternating loading schedule is to be continued until both tubs are full, which takes about 21 days when loaded at a rate of 200 lbs/day. Once the tubs are full, the composting mixture is to remain in the tubs for another week while the active (hot) phase of composting is completed.

When the hot phase of the composting cycle is completed (as determined by a drop in temperature in the composting mixture), the material is to be removed from the tubs and deposited in piles in a remote area on campus. The piles are then to sit and cure in the piles for another 30 days before use.

3.2.2 Daily Operations

Byron Drake, Assistant Director for Residential Dining, was given responsibility for overseeing the composting program. Building off the successes of the first composting program, Byron developed a Policy and Procedure document that defined the daily operations to be followed for pre-consumer waste collection and compost system operation. A copy of this document is included in the Appendix. The general daily operations followed for the first composting cycle are described below.

Approximately 200 lbs/day of pre-consumer food waste is separated by kitchen staff and deposited in one of eight specially marked 20-gallon plastic garbage containers located conveniently around the food preparation areas. All kitchen staff is trained to recognize which types of waste can and cannot be deposited into the compostables (food waste) containers. If in doubt, the staff is trained to deposit waste in regular garbage containers to avoid contamination of the compost. A copy of the food waste compost policy and procedure developed for this project is provided in the Appendix.

At the end of each day (or sooner if waste in the container reaches the full mark), each of the food waste containers is weighed and then emptied into one of the Earth Tubs. The weight of each container is recorded on a data log sheet along with the outdoor (air) temperature and the temperature of the material inside the tub. After all of the food waste is emptied into the Earth Tub, the tub's contents are mixed using the motorized mixing auger mounted in the tub's lid.

Recall that the entire quantity of bulking agent needed for one composting cycle is added at the beginning of the cycle when the tub is still empty, so it is not necessary to add bulking agent along with the food wastes. However, if the compost mixture appears to be too wet, additional bulking agent is added along with the food waste.

3.2.3 Data Collection

Data collected during the first composting cycle of the demonstration project include:

- Volume of bulking agent added at the start of the composting cycle
- Weight of each food waste bucket deposited into a tub
- Outside air temperature
- Compost mixture temperature

4.0 INITIAL EXPERIENCES

4.1 Project Start-Up

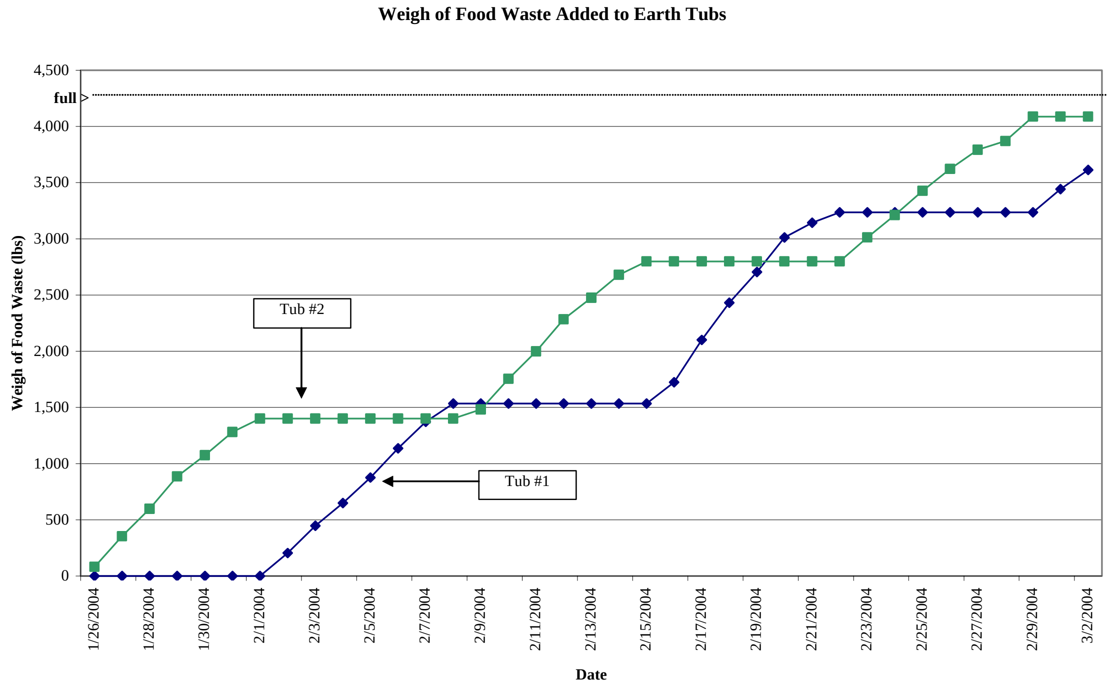
The initial experiences of the project were marked with both excitement and frustration. The excitement stemmed from the fresh start, the collaborations, access to external funding, and the sense that this time, the project would be a success. The frustration resulted from innumerable delays, difficulties in cross-campus cooperation, uncertainties in how to solve problems that arose, and the ultimate abandonment of the first batch of compost.

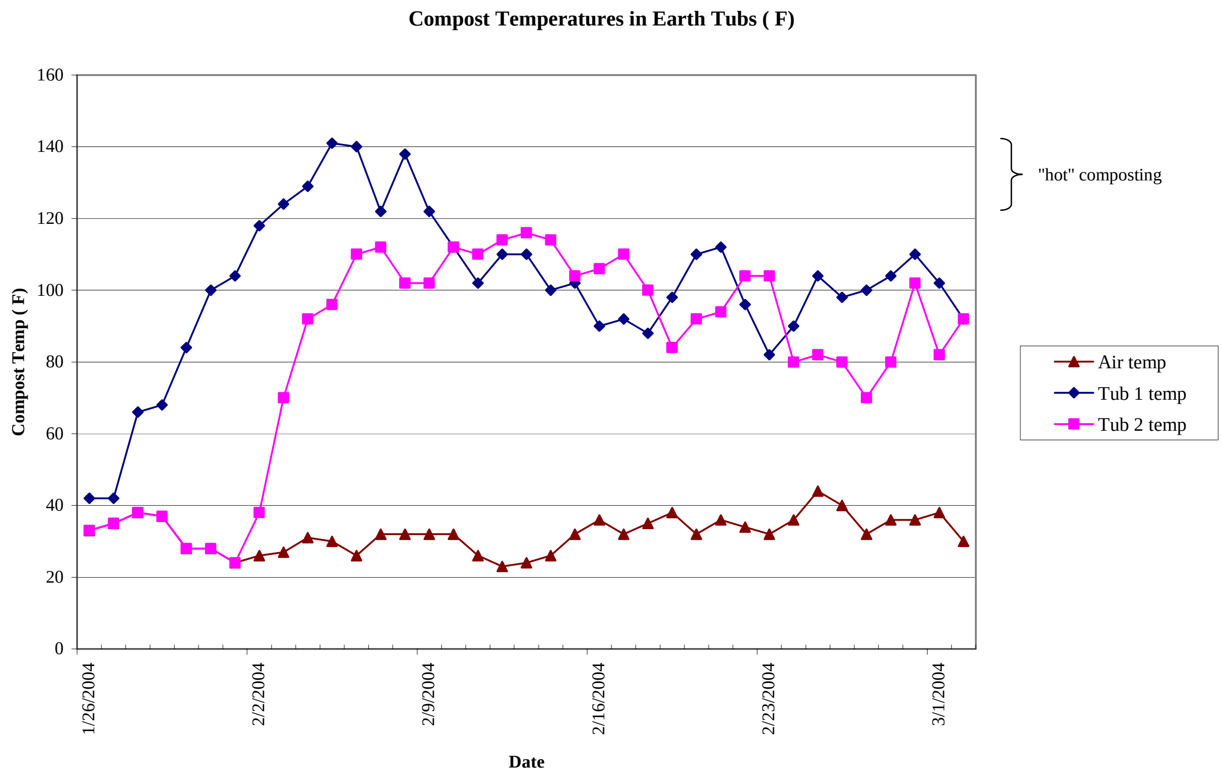
4.2 First Batch of Compost

The first loads of food waste were added to the first tub on January 26, 2004. The composting procedures outlined in Section 3.0 were successfully followed for several weeks. However, after a couple of weeks, mold began growing on the compost mixture. It was unclear whether or not the mold indicated a problem with the composting or even a health threat, but mixing was increased to twice per day. After 3 or 4 weeks, the composting mixture appeared to become excessively wet and temperatures inside the tubs began dropping. This problem was addressed by eliminating the recycling of leachate back into the composting mixture, eliminating the addition of very wet food wastes (such as soup), adding extra bulking agent, and running the blowers 24 hours a day. These measures initially seemed to help, but after several more days and complaints about odors and potential health hazards, the decision was made to abandon the first batch of compost. A contractor was hired to suck out the wet composting material from the tubs and haul it to a local farm where it could be mixed with additional bulking agent and composting in windrows.

Food waste weights and composting mixture temperature data collected during the first composting batch are presented in the tables on the following page and in the Appendix.

Investigations indicated that the problems most likely arose from clogging of the drainage and/or aeration systems that were caused by improper set-up. To remedy this problem, the systems were cleaned out, the drainage system was plumbed into the sanitary sewer, and the tubs were set-up more carefully and in accordance with instructions provided by the manufacturer. To help avoid this problem in the future, an easy-to-follow set-up procedure guide with photos was prepared. A copy of this guide is included in the Appendix.


Weigh of Food Waste Added to Earth Tubs
Weigh of Food Waste (lbs)
full
Tub #2
Tub #1
Date


Compost Temperatures in Earth Tubs (F)
Compost Temp (F)
"hot" composting
Air temp
Tub 1 temp
Tub 2 temp
Date

4.3 Lessons Learned

The following is a list of some of the many lessons learned from establishing and operating the first cycle of the compost demonstration project.

- Establishing the compost program took a very long time, even with the support of key administrators and faculty on campus. The idea was first proposed to the campus recycling committee in September 2002. The system was first used in January 2004, a year and a half later.

- It was recognized that composting food waste would require the active cooperation of Dining Service and Facilities Services. However, it would have been a good idea to also include someone from Environmental Health and Safety to proactively address their potential concerns. Furthermore, a Memorandum of Understanding (MOU) should be developed and signed by all parties.

- Developing initial marketing pieces to sell the idea up front to the campus community and to residents of the buildings closest to the composting system would be appropriate and beneficial.

- There are very few small-scale in-vessel commercial composting systems available on the market. This significantly limits choices.

- Establishing the composting system was more expensive than originally anticipated. The tubs, associated equipment, and installation materials cost approximately $18,000, but site preparation ended up costing $20,000 (though some of this site preparation cost was not directly related to the composting system.). Unforeseen expenses including $1,200 to remove all of the material from the tubs and clean the tubs and the compost area after the first batch of compost failed, and $1,100 to retrofit the tubs to improve drainage. Overall, installation and start-up cost a total of almost $40,000.

- Establishing and operating the compost system took more staff time than expected. However, it would have been better if even more time were spent on discussions with key personnel to anticipate potential problems and determine how such problems would be handled before they arose.

- Establishing the demonstration project required volunteer time from staff, faculty, students, and private sector. Though needed volunteers were found, people typically backburner their volunteer work when they get busy, and they always end up getting busy. For this reason, it is important to have paid staff and/or outside contractors assigned to getting the system up and running.

- Enthusiasm was very important to get the project off the ground, but insufficient to make specific activities happen.

- It was relatively easy for Dining Services to train their own kitchen staff to separate food wastes, collect food waste containers, and operate the composting system. However, it was not clear who should do what when problems arose.

- It is important to have one person, who has authority over appropriate staff, to oversee and be responsible for the composting program. It was difficult to coordinate activities and tasks across departments.

- Expect complaints. Complaints arose that the system was generating odors, even though the composting system was installed next to garbage dumpsters, which, arguably, generate more odors. Complaints also arose regarding the cost of the system.

- Expect problems and have plans in place to deal with them. The system didn't operate as expected and it was difficult to figure out how to fix problems. Some examples include:

    - Mold was found growing in the composting mixture. There was concern that this indicated the system was not working properly. This problem was addressed at first by adding more bulking agent, then later by stirring the mixture twice a day. There was additional concern that the mold presented a health hazard to the staff assigned to operate the system. University personnel from the health service and environmental safety thought the mold was not a problem, but were unsure.

    - The composting mixture became too wet. This problem was addressed by stopping the practice of recycling leachate back into the mixture, stopping the addition of soup, adding extra bulking agent, and running the blowers 24/7. In retrospect, the compost recipe should have been better evaluated before the first cycle was initiated.

    - The compost mixture heated up within days of the addition of the first food waste, but the temperature leveled off lower than expected. It took a couple of weeks to realize that the aeration and/or drainage system were not working properly.

- Clogging or malfunctioning of the drainage and/or aeration systems will lead to excess moisture and odors. Connecting the drainage system to a sanitary system will help to minimize odors caused by leachate.

- It would have been a good idea to have someone with composting experience monitor the equipment set-up and system operations for the first batch of compost. Early recognition of problems would have limited negative consequences.

- Take into account time required to properly maintain the units, hire a separate person to do this if possible.

5.0 OUTREACH ACTIVITIES

The EPA grant that provided partial funding for the Earth Tubs also provided funding for selected outreach activities. These activities included the preparation of this report and presentation of two workshops at other college campuses in Montana. Other outreach and education activities associated with the food waste composting demonstration project include a special-topics class on composting, development of a web page, scheduling of demonstration days, and preparation of system operation guide materials.

5.1 Workshops

A 4-hour workshop was developed as a means by which to share the experience of the UM demonstration project. The workshop consists of up to three presentations: (1) Composting Basics, (2) University of Montana's Food Waste Composting Project, and (3) Staring a Composting Program; with addition time for an open question and discussion session. Copies of the slides used in the presentations are provided in the Appendix.

One full 4-hour workshop was presented at Montana State University in Bozeman on April 20, 2004. A shorter one-hour workshop was presented at Carroll College on April 22, 2004. Both groups were left with copies of the 3 presentations and a draft of this report for future reference.

5.2 Courses

Collaborating faculty were encouraged to find ways to incorporate the composting project into their courses and research. So far, two professors have already integrated the project into their courses.

Tom DeLuca, professor of soils in the School of Forestry, developed a class for Fall of 2003 called Special Problems in Soil Biology - Composting of University Wastes. The objectives of the class were to explore the chemistry, biology and biochemistry of composting through the review of existing literature and the analysis and evaluation of compost generated on campus using a new in-vessel composting system. Students reviewed literature on a given method of analysis, prepared a method outline (using a specific format), and performed the analyses at 3 to 5 periods during the course of the semester. Unfortunately, the unexpected delay in project start-up meant that there was no composting system in place with which to conduct analyses. However, the food waste separation was already underway in the kitchens, so students performed analyses on food wastes.

Dr. DeLuca is currently (spring 2004) teaching a course called Environmental Soil Science. As part of this class, Dr. DeLuca is having several student measure and monitor daily moisture content in the composting material for several weeks. The subjective hand-measured moisture contents are being compared to moisture contents measured in the lab.

Neva Hassanein, professor in the Environment Studies Department, is currently (spring 2004) teaching a class called Food, Agriculture, and the Environment. As part of this class, Dr. Hassanein is directing 3 students in the development of two demonstration days (described below).

Dr. Hassanein is also planning on having students make presentations and give tours of the composting system as part of the Farm to College Day slated to occur at the University of Montana May 6th, 2004.

5.3 Web Site

A former student is in the process of developing a web site for the composting project in conjunction with the staff of Dining Services that will become a part of the University of Montana's Dining Services web page (http://www.umt.edu/uds/Earth_Tubs/index.htm). Numerous project cooperators provided materials for this page.

5.4 Demonstration Days

Two demonstration days have been planned by 3 students under the direction of Neva Hassanein, assistant professor in the Environmental Studies Program, as part of her Farm, Agriculture, and Environment class (EVST 450). The first demonstration day, designed for campus and community members, was conducted April 20, 2004 as part of Earth Week. The agenda included a series of presentations along with tours of the composing system. Notices for the demonstration days are being sent to two local radio stations, the three local newspapers, TV stations, local community organizations and list serves; posted on campus and around town; and presented at tables at the University Center. The second demonstration day will be held during Farm to College Day scheduled for May 6th, and/or at another date if a different venue appears to present a better opportunity.

The students are also working with local high schools to develop continuing work/learning opportunities revolving around composting and compost use.

5.5 Media Coverage

The University of Montana school newspaper, The Kaiman, and the local city paper, The Missoulian, ran articles on the compost operation. Copies of these articles are presented in the Appendix.

6.0 FUTURE PLANS

The food waste composting program began composting food waste for the first time on January 26, 2004. Though the first composting cycle had to be abandoned, the second cycle is near completion and appears to be working well. At the time of writing this report (April 2004), the immediate future plans for this project are simply to operate the system successfully for at least one year. Two professors have, and plan to continue, using the composting system as part of their class curriculum.

It is hoped that the successful operation of this system will lead to an expansion of organic waste composting on the University of Montana campus, the initiation of composting projects on other Montana campuses, and increase in composting throughout the community. Presentation materials prepared for the workshops presented at MSU and Carroll College are available for others to present at other institutions that express interest.

One vision includes developing a large-scale cooperative campus-community composting operation. The project envisioned would involve composting clean organic wastes generated by campus facilities and by local businesses and residences. Initial estimates suggest that such a project would cost in the millions of dollars and would require the leadership of key University and City or County officials as well as the cooperation of BFI Waste Management, which provides local waste hauling and landfilling services. It would also require a tireless champion and drivers beyond economics and environmental compliance. It is hoped that this demonstration project will help spark the interest of future champions and reveal the multiple benefits of composting.

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University of Montana – Dining Services

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APPENDICES

Photos of Food Waste Composting System

Food Waste Composting Policy and Procedure

Data Collected During First Composting Batch

Earth Tub Set-Up Procedure Guide

Copies Presentations Used in Workshops

Articles Printed in The Kaiman and The Missoulian

Photos of Food Waste Composting System

 One of eight food waste collection containers	 Two of eight compost data logs
 Food waste collection container #8	 Earth Tub #1 with Mark LoParco (left) and Byron Drake
 Biofilter used for the composting system	 Mixture in Tub #1 early in composting cycle

Food Waste Composting Policy and Procedure

Dining Services Earth Tubs - Composting

Policy & Procedure: Earth Tubs – Composting – Pre-consumer waste collection
Date Adopted: Oct, 1, 2003
Revisions: DRAFT
References:
Approved by:

POLICY:

The purpose of this policy is to define the process of pre-consumer waste collection for The Lommasson Center food operations. The Assistant Director for Residential Dining will act as the coordinator for these procedures.

Overview: The Earth Tubs are enclosed composting devices purchased in part by University Dining Services and a U.S. EPA grant. They are located behind the Food Zoo Kitchen and are part of a cooperative recycling initiative involving University Dining Services, Facilities Services, Environmental Studies and the School of Forestry. Pre-consumer waste will be removed from the Lommasson Center kitchens, weighed, logged and added to the Earth Tubs.
Facility Services will unload, rest, store, and use the resulting compost on University grounds.

PROCEDURE:

1. The Food Zoo Kitchen Manager:

a. Will purchase eight, 20 gallon, composting buckets with lids.
   i. Each bucket will be marked with a location, a number, a fill line, and will include a clear plastic envelope secured to the lid for notes.
   ii. Eight locations within the kitchens will be clearly and permanently marked for the buckets.
   iii. Locations will include La Peak and the Cascade Country Store.

b. Will be responsible for the training and follow-up of the kitchen culinary and cleanup staff for all procedures relating to this project.
   i. All pre-consumer food waste will be added to the compost buckets with the following conditions or exceptions:
      1. No plastic, waxed paper, or metal of any kind should go in the buckets.
      2. Bones should not go in the buckets.
      3. Large amounts of protein (over 10 pounds) need to be recorded on the bucket notes.

4. Any unusual additions should be noted on the bucket notes.
5. Any time the bucket is dumped during the day, this must be recorded on the bucket notes.

2. The UDS Custodial Manager:

a. Will carefully weigh each bucket and record the weights on the composting log. They will also record any appropriate notes related the log. Empty buckets will be recorded as 0.
b. They will then empty all buckets into the appropriate Earth Tub and walk the auger around one time.
c. They will then record the outside temperature and the mass temperature on the log.
d. Each compost bucket will be sprayed clean nightly following this operation.
e. When the log is complete (one month) the UDS custodial manger will turn the log into the assistant director for review.
f. Any mechanical issues or problems with the tubs shall be reported to the assistant director and the Lommasson Center Maintenance Supervisor immediately.

3. The Lommasson Center Maintenance Supervisor:

a. Will purchase and post a quality outside thermometer in the Earth Tub area out of the direct sunlight to record outside temperatures.
b. Will be responsible for maintaining the cleanliness of the area, and maintenance of the Earth Tubs.
c. They will also order additional bulking agent from facilities when needed.

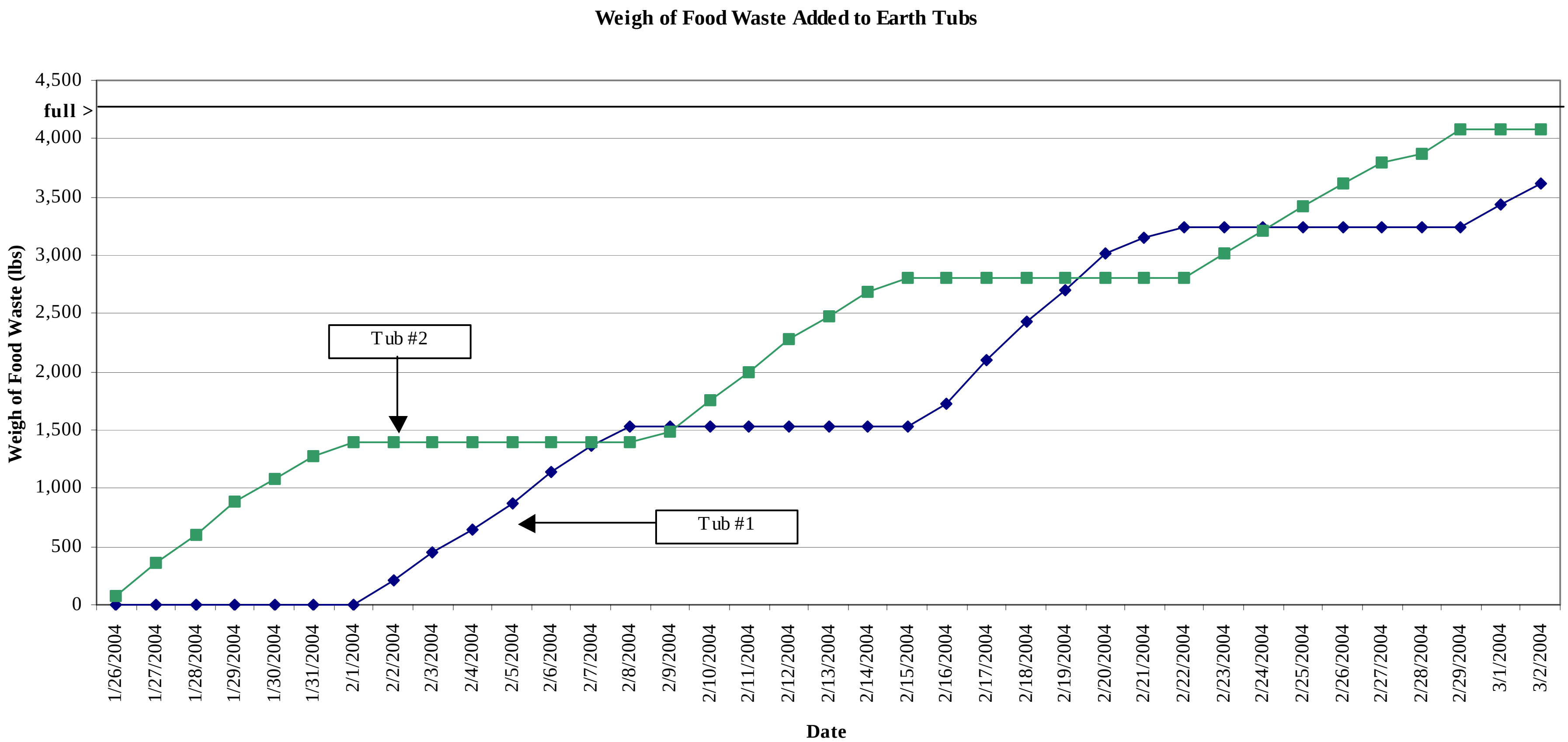
4. The Assistant Director for Residential Dining:

a. Will review the procedures and policies as needed to effectively continue this program.
b. The University Recycling committee will review gross changes in policies and procedures.
c. Analysis of the logs, compost and pre-consumer waste will be performed by the classes and or graduate students form the School of Forestry or Environmental Studies.

Date	Air Temp.	Tub Temp.	Bucket #1 (Lbs.) *	Bucket #2 (Lbs.)	Bucket #3 (Lbs.)	Bucket #4 (Lbs.)	Bucket #5 (Lbs.)	Bucket #6 (Lbs.)	Bucket #7 (Lbs.)	Bucket #8 (Lbs.)	Total Daily Gross Wt.	Total Daily Net Wt.
Notes												
Notes												
Notes												
Notes												
Notes												
Notes												
2/1/2004												
Notes												
Weekly Gross Wt.												
Weekly Net Wt.												

Buckets weigh 7 pounds empty

Data Collected During First Composting Batch


Weigh of Food Waste Added to Earth Tubs
4,500
full >
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Weigh of Food Waste (lbs)
Tub #2
Tub #1
1/26/2004
1/27/2004
1/28/2004
1/29/2004
1/30/2004
1/31/2004
2/1/2004
2/2/2004
2/3/2004
2/4/2004
2/5/2004
2/6/2004
2/7/2004
2/8/2004
2/9/2004
2/10/2004
2/11/2004
2/12/2004
2/13/2004
2/14/2004
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2/16/2004
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2/18/2004
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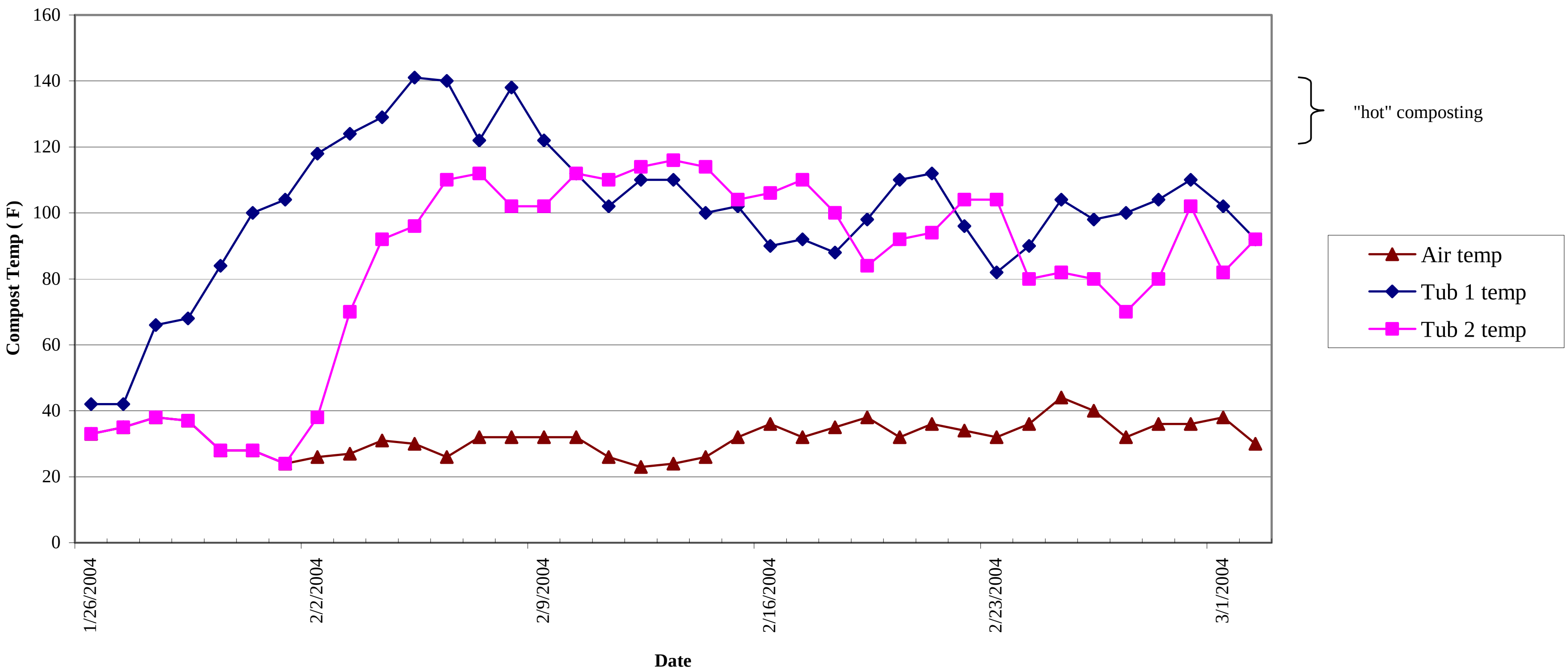
2/22/2004
2/23/2004
2/24/2004
2/25/2004
2/26/2004
2/27/2004
2/28/2004
2/29/2004
3/1/2004
3/2/2004
Date

Compost Temperatures in Earth Tubs (F)



University of Montana Dining Services
Food Waste Composting Demonstration Project

Bucket weight empty = 7
pounds
Bucket filled volume = approx 10 gallons

Gross Weight of Food Waste Buckets added to Earth Tubs

	Bucket 1 (lbs)	Bucket 2 (lbs)	Bucket 3 (lbs)	Bucket 4 (lbs)	Bucket 5 (lbs)	Bucket 6 (lbs)	Bucket 7 (lbs)	Bucket 8 (lbs)
1/26/2004	6	9	21	19	0	10	16	49
1/27/2004	81	17	34	48	15	19	39	75
1/28/2004	60	11	53	48	25	9	23	72
1/29/2004	107	21	39	54	27	7	21	68
1/30/2004	23	7	17	21	51	37	32	59
1/31/2004	76	48	36	45	8	35	0	0
2/1/2004	24	9	35	56	16	22	0	0
2/2/2004	48	19	31	16	29	29	23	66
2/3/2004	52	37	11	53	16	40	20	72
2/4/2004	46	18	22	39	21	23	26	65
2/5/2004	41	14	31	32	29	26	41	71
2/6/2004	52	39	35	31	19	43	25	72
2/7/2004	66	18	44	6	32	113		
2/8/2004	47	32	47	19	33	27		
2/9/2004	74	20	43	11	59	30	12	72
2/10/2004	64	38	31	25	19	45	30	91
2/11/2004	55	62	40	0	11	22	27	30
2/12/2004	60	30	37	0	3	75	23	112
2/13/2004	46	12	16	23	0	50	30	79
2/14/2004	64	9	15	13	0	58	0	0
2/15/2004	47	32	47	19	33	27	0	0
2/16/2004	44	40	57	49	22	20	0	0
2/17/2004	61	74	83	31	50	10	37	89
2/18/2004	60	27	52	110	23	14	21	82
2/19/2004	39	45	33	25	22	50	35	80
2/20/2004	39	55	18	26	17	44	61	105
2/21/2004	60	51	20	26	9	0	0	0
2/22/2004	36	11	19	33	14	21	0	0

2/23/2004	66	32	5	26	16	30	5	88
2/24/2004	35	6	33	34	11	22	42	70
2/25/2004	36	28	29	29	26	8	36	81
2/26/2004	45	22	55	16	7	8	22	76
2/27/2004	42	7	32	12	14	1	47	67
2/28/2004	27	9	33	0	37	0	0	0
2/29/2004	34	17	31	51	103	24	0	0
3/1/2004	73	30	14	21	8	21	18	77
3/2/2004	51	19	4	16	22	18	31	63

END OF FIRST BATCH – TUBS EMPTIED

CONTINUE TO RECORD FOOD WEIGHTS, BUT THROW IN DUMPSTER

3/3/2004	20	36	19	32	20	1	15	73
¾/2004	16	29	27	12	57	17	23	39
3/5/2004	50	23	29	8	9	0	41	72
3/6/2004	27	5	47	29	45	0	0	0
3/7/2004	27	26	34	13	5	9	0	0
3/8/2004	45	12	21	24	21	9	13	96
3/9/2004	63	38	14	26	13	29	17	69
3/10/2004	23	22	32	6	12	9	21	86
3/11/2004	18	12	23	18	5	42	16	75
3/12/2004	66	20	18	8	23	0	34	80
3/13/2004	40	28	57	10	0	0	0	0
3/14/2004	3	6	25	12	16	2	0	0
3/15/2004	20	5	41	14	10	12	11	26
3/16/2004	26	21	32	27	34	23	24	79

START SECOND BATCH OF COMPOSTING

3/17/2004	47	17	39	25	15	7	33	87
3/18/2004	53	30	22	5	12	16	11	87
3/19/2004	105	7	45	5	10	0	29	63
3/20/2004	52	43	19	6	0	0	0	0
3/21/2004	15	6	22	35	6	8	0	0

spring break

(DATA COLLECTION TO BE CONTINUED)

Date	Air Temp.	Tub Temp.	Bucket #1 (Lbs.) *	Bucket #2 (Lbs.)	Bucket #3 (Lbs.)	Bucket #4 (Lbs.)	Bucket #5 (Lbs.)	Bucket #6 (Lbs.)	Bucket #7 (Lbs.)	Bucket #8 (Lbs.)	Total Daily Gross Wt.	Total Daily Net Wt.
1/26/2004	33	42	6	9	21	19	0	10	16	49	130	81
Notes												
1/27/2004	35	42	81	17	34	48	15	19	39	75	328	272
Notes												
1/28/2004	38	66	60	11	53	48	24.5	9	23	72	300.5	244.5
Notes												
1/29/2004	37	68	106.5	21	38.5	54	27	7	20.5	68	342.5	286.5
Notes						Lots of ash from the grill						
1/30/2004	28	84	23	7	16.5	21	51	37	32	59	246.5	190.5
Notes												
1/31/2004	28	100	76	48	36	45	7.5	35	0	0	247.5	205.5
Notes			Average air temperature F. 31.86 degrees						closed	closed		
2/1/2004	24	104	24	8.5	35	56	15.5	21.5	0	0	160.5	118.5
Notes			Gradient Mass temp F. 7 days		"+62 degrees				closed	closed		
Weekly Gross Wt.			376.5	121.5	234	291	140.5	138.5	130.5	323	1755.5	1398.5
Weekly Net Wt.			327.5	72.5	185	242	98.5	89.5	95.5	288	1398.5	

Date	Air Temp.	Tub Temp.	Bucket #1 (Lbs.) *	Bucket #2 (Lbs.)	Bucket #3 (Lbs.)	Bucket #4 (Lbs.)	Bucket #5 (Lbs.)	Bucket #6 (Lbs.)	Bucket #7 (Lbs.)	Bucket #8 (Lbs.)	Total Daily Gross Wt.	Total Daily Net Wt.	tub 1 temp
2/2/2004	26	38	48	19	305	15.5	29	29	23	65.5	534	478	118
Notes													
2/3/2004	27	70	51.5	36.5	10.5	52.5	16	40	19.5	72	298.5	242.5	124
Notes													
2/4/2004	31	92	45.5	18	22	39	21	23	26	65	259.5	203.5	129
Notes													
2/5/2004	30	96	41	13.5	30.5	32	29	25.5	41	71	283.5	227.5	141
Notes													
2/6/2004	26	110	52	38.5	34.5	30.5	18.5	43	25	71.5	313.5	257.5	140
Notes										Almost to top rim			
2/7/04/	32	112	66	17.5	44	6	32	113			278.5	236.5	122
Notes			Average air temperature F. 29.14 degrees						closed	closed			
2/8/04/	32	102	47	31.5	47	19	33	27			204.5	162.5	138
Notes			**Tub 2** Gradient Mass temp F. 7 days			"+88 degrees			closed	closed			
Weekly Gross Wt.			351	174.5	493.5	194.5	178.5	300.5	134.5	345	2172	1808	
Weekly Net Wt.			302	125.5	444.5	145.5	129.5	251.5	99.5	310	1808		

Average Temperature tub #1 130.2857
Average temperature tub #2 88.57143 outside air temp 29.14

Buckets weigh 7 pounds empty

Date	Air Temp.	Tub Temp.	Bucket #1 (Lbs.) *	Bucket #2 (Lbs.)	Bucket #3 (Lbs.)	Bucket #4 (Lbs.)	Bucket #5 (Lbs.)	Bucket #6 (Lbs.)	Bucket #7 (Lbs.)	Bucket #8 (Lbs.)	Total Daily Gross Wt.	Total Daily Net Wt.	Tub 2 Temp.
2/9/2004	32	122	73.5	20	42.5	10.5	59	30	11.5	72	319	263	102
Notes													
2/10/2004	32	112	63.5	38	30.5	25	19	45	30	90.5	341.5	285.5	112
Notes						Ham			Eggs, Taco meat, Nacho Cheese				
2/11/2004	26	102	55	62	40	0	11	22	27	30	247	198	110
Notes						Full of trash; Had to throw out							
2/12/2004	23	110	60	30	36.5	0	3	75	23	112	339.5	290.5	114
Notes						Full of trash; Had to throw out							
2/13/2004	24	110	46	12	16	22.5	0	49.5	30	79	255	206	116
Notes													
2/14/2004	26	100	64	9	14.5	12.5	0	57.5	0	0	157.5	122.5	114
Notes			Salmon				Empty		closed	closed			
			Average air temperature F. 27.86 degrees										
2/15/2004	32	102	47	31.5	47	19	33	27	0	0	204.5	162.5	104
Notes			**Tub 1** Gradient Mass temp F. 7 days -20 degrees						closed	closed			
Weekly Gross Wt.			409	202.5	227	89.5	125	306	121.5	383.5	1864	1528	
Weekly Net Wt.			360	153.5	178	54.5	90	257	86.5	348.5	1528		
Average Temperature tub #1				108.2857									
Average temperature tub #2				110.2857	Outside air temp		27.86						
Buckets weigh 7 pounds empty													

Date	Air Temp.	Tub Temp.	Bucket #1 (Lbs.) *	Bucket #2 (Lbs.)	Bucket #3 (Lbs.)	Bucket #4 (Lbs.)	Bucket #5 (Lbs.)	Bucket #6 (Lbs.)	Bucket #7 (Lbs.)	Bucket #8 (Lbs.)	Total Daily Gross Wt.	Total Daily Net Wt.	Tub 1 Temp.
2/16/2004	36	106	44	40	56.5	49	22	19.5	0	0	231	189	90
Notes									Holiday	Holiday			
2/17/2004	32	110	60.56	73.5	82.5	31	49.5	10	37	88.5	432.56	376.56	92
Notes													
2/18/2004	35	100	60	27	52	109.5	23	14	21	81.5	388	332	88
Notes			Blowers ON, 8 shovels of bulking agent added to # 1										
2/19/2004	38	84	39	45	33	25	22	50	35	80	329	273	98
Notes			8 shovels of bulking agent to # 1										
2/20/2004	32	92	39	54.5	18	26	17	43.5	61	105	364	308	110
Notes													
2/21/2004	36	94	60	51	20	26	9	0	0	0	166	131	112
Notes			Average air temperature F. 34.71 degrees						closed	closed			
2/22/2004	34	104	36	11	19	33	14	21	0	0	134	92	96
Notes			**Tub 2** Gradient Mass temp F. 7 days -6 degrees						closed	closed			
Weekly Gross Wt.			338.56	302	281	299.5	156.5	158	154	355	2044.56	1701.56	
Weekly Net Wt.			289.56	253	232	250.5	107.5	116	126	327	1701.56		
Average Temperature tub #1				98									
Average temperature tub #2				98.57143	Outside air temp		34.71						
Buckets weigh 7 pounds empty													

Date	Air Temp.	Tub Temp.	Bucket #1 (Lbs.) *	Bucket #2 (Lbs.)	Bucket #3 (Lbs.)	Bucket #4 (Lbs.)	Bucket #5 (Lbs.)	Bucket #6 (Lbs.)	Bucket #7 (Lbs.)	Bucket #8 (Lbs.)	Total Daily Gross Wt.	Total Daily Net Wt.	Tub 2 Temp.
2/23/2004	32	82	66	31.5	5	25.5	15.5	30	5	88	266.5	210.5	104
Notes			Over Fill Line	6 Scoops added to number 2									
2/24/2004	36	90	35	5.5	32.5	34	11	22	42	70	252	196	80
Notes			6 Scoops added to number 2										
2/25/2004	44	104	35.5	27.5	29	28.5	26	8	36	81	271.5	215.5	82
Notes			Add 2 scoops bulk to each tub each night										
2/26/2004	40	98	45	22	55	16	7	8	22	76	251	195	80
Notes			Add 2 scoops to each tub										
2/27/2004	32	100	42	7	31.5	11.5	14	1	47	67	221	165	70
Notes			Add 2 scoops to each tub										
2/28/2004	36	104	27	9	33	0	37	0	0	0	106	78	80
Notes			Average air temperature F. 36.57 degrees						closed	closed			
			Add 2 scoops to each tub										
2/29/2004	36	110	34	16.5	30.5	50.5	103	24	0	0	258.5	216.5	102
Notes			**Tub 2** Gradient Mass temp F. 7 days +28 degrees						closed	closed			
			Add 2 scoops to each tub										
Weekly Gross Wt.			284.5	119	216.5	166	213.5	93	152	382	1626.5	1276.5	
Weekly Net Wt.			235.5	70	167.5	124	164.5	51	117	347	1276.5		
Average Temperature tub #1				98.28571									
Average temperature tub #2				85.42857	Outside air temp		36.57						
Buckets weigh 7 pounds empty													

Date	Air Temp.	Tub Temp.	Bucket #1 (Lbs.) *	Bucket #2 (Lbs.)	Bucket #3 (Lbs.)	Bucket #4 (Lbs.)	Bucket #5 (Lbs.)	Bucket #6 (Lbs.)	Bucket #7 (Lbs.)	Bucket #8 (Lbs.)	Total Daily Gross Wt.	Total Daily Net Wt.	Tub 1 Temp.
3/1/2004	38	82	73	30	14	21	8	20.5	18	77	261.5	205.5	102
Notes													
3/2/2004	30	92	51	18.5	3.5	16	22	18	31	63	223	167	92
Notes													
3/3/2004	0	0	20	36	19	32	20	1	15	73	216	160	
Notes			Not being dumped into each tub										
3/4/2004	0	0	16	29	27	12	57	17	23	39	220	164	
Notes			Not being dumped into each tub										
3/5/2004	0	0	50	23	29	8	9	0	41	72	232	183	
Notes			Not being dumped into each tub										
3/6/2004	0	0	27	5	47	29	45	0	0	0	153	118	
Notes			Average air temperature F. 34.00 degrees						closed	closed			
3/7/2004	0	0	27	26	34	13	5	9	0	0	114	72	
Notes			**Tub 2** Gradient Mass temp F. 7 days +10 degrees						closed	closed			
Weekly Gross Wt.			264	167.5	173.5	131	166	65.5	128	324	1419.5	1069.5	
Weekly Net Wt.			215	118.5	124.5	82	117	30.5	93	289	1069.5		
Average Temperature tub #1				97									
Average temperature tub #2				87	Outside air temp		34.00						
Buckets weigh 7 pounds empty													

Date	Air Temp.	Tub Temp.	Bucket #1 (Lbs.) *	Bucket #2 (Lbs.)	Bucket #3 (Lbs.)	Bucket #4 (Lbs.)	Bucket #5 (Lbs.)	Bucket #6 (Lbs.)	Bucket #7 (Lbs.)	Bucket #8 (Lbs.)	Total Daily Gross Wt.	Total Daily Net Wt.	tub 1 temp
3/8/2004	0	0	45	12	21	24	21	9	13	96	241	185	
Notes													
3/9/2004	0	0	63	38	14	26	13	29	17	69	269	213	
Notes													
3/10/2004	0	0	23	22	32	6	11.5	9	21	86	210.5	154.5	
Notes													
3/11/2004	0	0	17.5	12	23	18	5	42	16	75	208.5	152.5	
Notes													
3/12/2004	0	0	66	20	18	8	22.5	0	34	80	248.5	199.5	
Notes													
3/13/2004	0	0	40	27.5	57	10	0	0	0	0	134.5	106.5	
Notes			Average air temperature F. N/A						closed	closed			
3/14/2004	0	0	3	6	24.5	12	16	2	0	0	63.5	21.5	
Notes			**Tub 2** Gradient Mass temp F. 7 days N/A						closed	closed			
Weekly Gross Wt.			257.5	137.5	189.5	104	89	91	101	406	1375.5	1032.5	
Weekly Net Wt.			208.5	88.5	140.5	55	47	56	66	371	1032.5		

Average Temperature tub #1 0
Average temperature tub #2 0 outside air temp NA

Buckets weigh 7 pounds empty

Date	Air Temp.	Tub Temp.	Bucket #1 (Lbs.) *	Bucket #2 (Lbs.)	Bucket #3 (Lbs.)	Bucket #4 (Lbs.)	Bucket #5 (Lbs.)	Bucket #6 (Lbs.)	Bucket #7 (Lbs.)	Bucket #8 (Lbs.)	Total Daily Gross Wt.	Total Daily Net Wt.	tub 1 temp
3/15/2004	0	0	20	5	41	14	10	11.5	11	26	138.5	82.5	
Notes													
3/16/2004	0	0	26	21	32	27	34	23	24	79	266	210	
Notes													
3/17/2004	46	60	47	17	39	25	15	7	33	87	270	214	
Notes			Begin Adding Compost to Tub #2 ONLY										
3/18/2004	60	60	53	30	22	5	12	16	11	87	236	180	
Notes													
3/19/2004	40	74	105	7	45	5	9.5	0	28.5	63	263	214	
Notes													
3/20/2004	40	102	52	43	19	6	0	0	0	0	120	92	
Notes			Average air temperature F. 29.14 degrees						closed	closed			
3/21/2004	44	104	15	6	22	35	6	8	0	0	92	50	
Notes			**Tub 2** Gradient Mass temp F. 7 days +44 degrees						closed	closed			
Weekly Gross Wt.			318	129	220	117	86.5	65.5	107.5	342	1385.5	1042.5	
Weekly Net Wt.			269	80	171	68	44.5	30.5	72.5	307	1042.5		
Average Temperature tub #1				0									
Average temperature tub #2				80	outside air temp		32.86						
Buckets weigh 7 pounds empty													

Earth Tub Set-Up Procedure Guide

Food Waste Composting Demonstration Project
University of Montana – Dining Services
April 2004

The Official Earth Tub Set-Up Instructional Packet

Or:

How to prepare to make great compost while avoiding foul odors

Questions? Contact:

UM-RECYCLE

FACILITIES SERVICES

243-5747 or 243-5795

Overview: Earth Tubs

1. Ensure tubs are clean and free of waste.
2. Add 1 ½ -2 90-gallon containers bark
3. Add 12-16 inches bulking agent on top of bark
4. Add 5-10 gallons finished compost

Overview: Biofilters

1. Empty and clean biofilters and PVC pipe.
2. Add six inches bark to cover aeration pipe.
3. In grey bin, mix 4 parts wood shavings (20 gallons) to 1 part compost (5 gallons), plus 1 quart lime.
4. Mix well.
5. Add mixture to biofilters.
6. Repeat steps 3-5.

Earth Tubs: Step One

- Ensure tubs are clean and free of waste.
- If necessary, clean aeration grate, or PVC piping.
- Make sure auger spins clockwise.

Earth Tubs: Step Two

- After emptying and cleaning the tubs, add 1 ½ - 2 90-gallon containers of bark.
- Spread bark along base of floor and ensure aeration grate is covered.

Step Three: Add bulking agent

- Add 12-16 inches bulking agent.
- Spread bulking agent evenly over bark, but do not mix bark with bulking agent.
- The tub should be approximately half full at this point.

Step Four: Add finished compost

- Pour 5 – 10 gallons finished compost on top of bulking agent

Biofilters: Step One

- Empty biofilters.
- Contents can be added to Earth Tubs as bulking agents.
- Wash container with water, drain water, and clean aeration pipe if necessary.
- Air dry.

Biofilters: Step Two

- Add approximately six inches bark to bottom of biofilter.
- Completely cover aeration pipe.

Biofilters: Step Three

- In grey bin mix 4 parts wood shavings with 1 part finished compost.
- Add 1 quart lime.
- One grey bin can accommodate 4 5-gallon buckets wood shavings plus 1 5-gallon bucket compost.

Biofilters: Step Four and Five

- Mix wood shavings, compost, and lime.
- Once the ingredients are well mixed, dump contents of grey bin into biofilter, on top of wood chips.

Biofilters: Step Six

- Repeat steps 3-5.
- Biofilter can hold at least 40 gallons wood shavings plus 10 gallons compost.
- Check to see that hoses are attached and blower works properly.

Copies of Presentations Used in Workshops

Composting Basics

Brought to you by …

? Prepared by:
  ? Denise K. DeLuca, P.E.
  Emergent Solutions

? Funded by:
  ? EPA Region 8 Pollution Prevention
  ? DEQ Business and Community Assistance Program

Composting Basics

? What we'll cover in the next hour …
  ? What is composting?
  ? What is compost?
  ? How do you make compost?
  ? Why compost?
  ? Why not compost?

What is Composting?

Composting is …

? an enhanced biological process in which microorganisms decompose organic materials into a stable humified product.

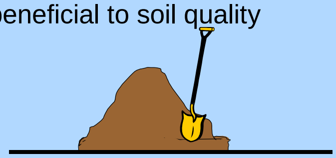
Composting is …

? an aerobic process
? a thermophilic process
? an enhanced or controlled process
? carried out by micro-organisms
  ? mostly bacteria
  ? some fungi
  ? some actinomycetes

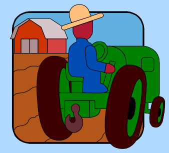
What is Compost?

Compost is …

? the finished product of composting
? a stabilized mixture of decomposed organic materials
? free of viable pathogens and seeds
? beneficial to soil quality



Uses of Compost



●Gardening
●Landscaping

●Farming

●Forestry
●Reclamation

What can be composted?

? 60% of municipal solid waste
  ? food waste
  ? paper waste
  ? yard waste
? 100% of some waste streams
  ? sewage sludge
  ? manure and other farm residues
  ? wood and paper processing wastes
  ? food waste

What cannot be composted?

? Non-degradable materials
  ? Glass
  ? Plastic
  ? Metal
? Toxic or hazardous wastes

How do you make compost?

? Steps in the composting process:
1. Collection and delivery of materials
2. Pre-Processing
3. **Active Composting**
4. Curing
5. Post-Processing

1. Collection and Delivery

? Need to consider:
  ? Source of material
    ? type of material
    ? timing
  ? Level of cooperation
    ? source separation
  ? Cost or revenue?

2. Pre-Processing

? Open plastic bags
? Remove non-compostable materials
? Reduce particle size
? Make compost mixture

2. Pre-Processing

? Compost Recipe:
  ? Carbon-to-Nitrogen ratio = 30
  ? Moisture content = 50%
  ? Additional considerations
    ? relative degradability
    ? material structure (bulk)

3. Active Composting

? The “hot” stage (thermophilic)
? Main task: keep bacteria happy
  ? aerobic
  ? moist but not wet
? Requires monitoring
  ? temperature
  ? moisture
  ? odor
  ? (oxygen)

3. Active Composting

? Technology Options:
  ? Static piles
    ? passive aeration
    ? active aeration
  ? Turned windrows
  ? Bins
  ? In-Vessel

3. Active Composting
Static Pile

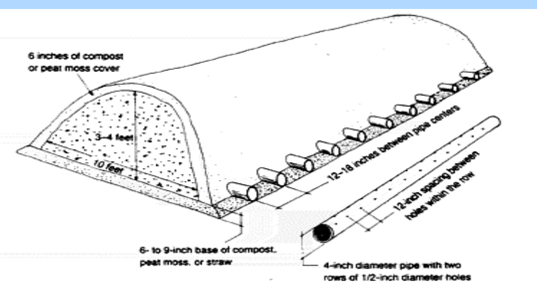
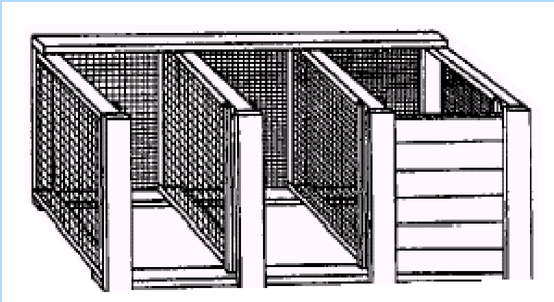


Figure 4.7
Passively aerated windrow method for composting manure.

3. Active Composting

? **Static Piles**
  ? Can be very low tech
  ? Low on-going labor
  ? High space requirement
  ? Slowest composting process
  ? Requires careful initial mixing
  ? Materials
    ? should be homogeneous
    ? requires good internal structure

3. Active Composting
Bins



3. Active Composting
Bins

3. Active Composting
Bins

3. Active Composting
Bins

? Bins
  ? Very low tech
  ? Can be “home-made”
  ? Small scale
  ? Very adaptable
  ? Low maintenance
  ? Slowest composting process
  ? Vermicomposting alternative

3. Active Composting
Turned Windrows

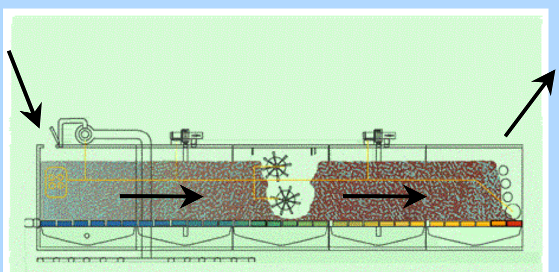
3. Active Composting

? **Turned Windrows**
  ? Can be very low tech
  ? Requires labor for turning
  ? Faster than static pile composting
  ? High space requirement
  ? Materials
    ? Need not be homogeneous
    ? Can compost materials that tend to settle

3. Active Composting
In-Vessel

3. Active Composting
In-Vessel

3. Active Composting
In-Vessel



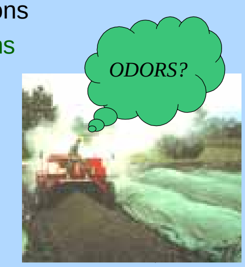
3. Active Composting
In-Vessel

3. Active Composting

? **In-Vessel**
- ? Many designs available
- ? Continuous or batch processing
- ? Best control, so fastest
- ? Lowest space requirement
- ? Highest tech
- ? Most expensive

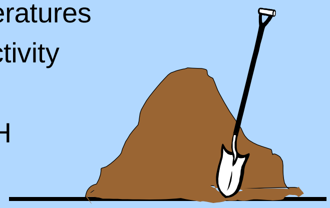
3. Active Composting

? Odor Management
- ? Include in system planning and design
- ? Include in system operations
- ? Maintain aerobic conditions
- ? Options:
  - ? distance
  - ? ventilation and treatment
    - biofilter
    - scrubber



4. Curing

? Final stage of decomposition
? Aerobic
? Mesophilic temperatures
? Less microbial activity
? Humus formation
? Shift to neutral pH



5. Post-Processing

? Depends on compost end use
? Could include:
  ? Storage
  ? Testing
  ? Screening
  ? Blending
  ? Pelletizing
  ? Packaging

5. Post-Processing **Screening**

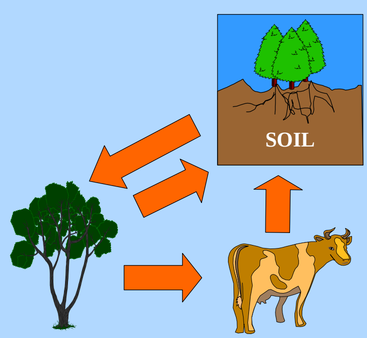
Why Compost?

? What do you think?

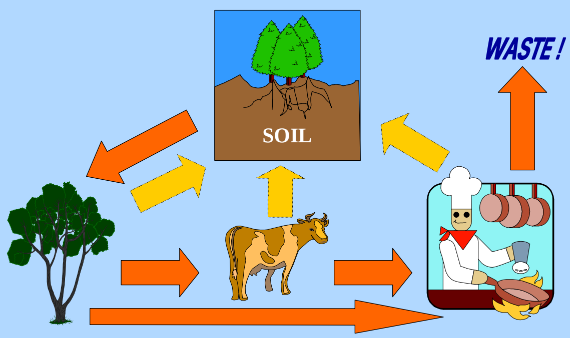
Why Compost?

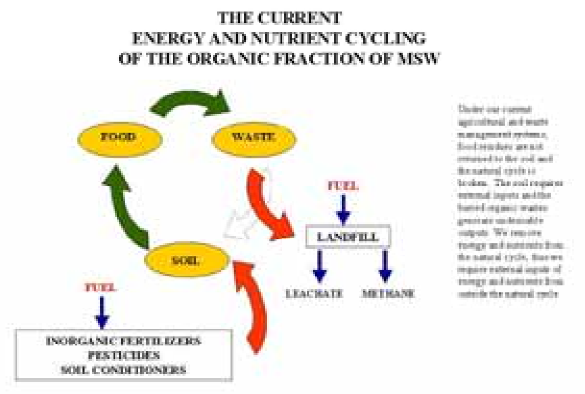
? Composting and Compost can provide
  ? a way for people to take part in necessary natural cycles
  ? a research and educational tool
  ? a way to save money
    ? but not necessarily

Organic Matter Cycling … without people



Organic Matter Cycling
… with people





Problem #1

? Organic matter becomes waste material
- ? **solid waste**
  - ? Landfill >> leachate, greenhouse gases
  - ? Incinerate >> greenhouse gases, particulate
- ? **sewage sludge**
  - ? land apply
  - ? landfill
  - ? incinerate

Problem #2

? Soils become depleted
- ? requires more pesticides
- ? requires more fertilization
- ? requires more water

? More energy consumed
- ? inorganic fertilizers require lots of energy to produce

so …
Why Compost?

? Composting provides an alternative to:
- ? landfilling
- ? anaerobic digestion
- ? incineration
- ? undesirable land application

? Compost provides an alternative to:
- ? inorganic fertilizers and other soil amendments

Why *Not* Compost?

? What do you think?

Why *Not* Compost?

? Some nutrients and energy are lost
? Requires management
? Can be expensive
? Requires commitment
? Requires permits
? Must market or use finished compost
? Public perception

The important lesson ...

Starting a Food Waste Composting Program

Brought to you by …

- ? Prepared by:
  - ? Denise K. DeLuca, P.E.
    Emergent Solutions
- ? Funded by:
  - ? EPA Region 8 Pollution Prevention
  - ? DEQ Business and Community Assistance Program

Steps for Starting a Food Waste Composting Project

1. Educate
2. Find champion and collaborators
3. Collect information
4. Design project
5. Address permitting issues
6. Identify costs and funding sources

1. Education

- ? Education is very important!
  - ? Generates excitement, ideas, support
    - ? Marketing to key people
  - ? Misconceptions are common
  - ? Perception is reality

1. Education

- ? Need answers for basic questions:
  - ? What is compost?
  - ? What is composting?

  - ? Why compost?
  - ? Why *not* compost?

Why compost?

- ? Possible project drivers:
  - ? Recycling or sustainability goals
  - ? Education and research
  - ? Marketing tool
  - ? Save money
    - ? Waste management
      - On campus
      - On farm
    - ? Landscaping materials
  - ? More? Look for more drivers!

Why compost?

? What are your drivers?

Why *not* compost?

? Possible project killers:
  - ? Lack of compostable materials
  - ? Lack of cooperation
  - ? Lack of commitment
  - ? Complaints from neighbors
  - ? Permitting
  - ? Lack of funding
    - ? In Montana, money savings alone probably won't justify the expense!

Why *not* compost?

? What are your possible project killers?

2. Potential Collaborators

? Dining Services
  - ? Food waste generation and handling

? Facilities Services
  - ? Waste management
  - ? Operations and Maintenance

? Administration
  - ? Budgets, promotions

? Farm Management
  - ? Manure, ag waste, possible composting site, compost user

? Students, faculty

? Community

Look for a project champion!

2. Potential Collaborators

? Who are your potential collaborators?

? Who are your potential champions?

3. Collect Information

? What can we compost?
  - ? Conduct a waste audit

? How can we compost?
  - ? Research technology options

? Where can we compost?
  - ? Investigate possible composting sites

What can we compost?

? Basic Compost Recipe
  - ? Greens + Browns
    - ? Green waste:
      - – Food waste, manure, grass
    - ? Brown waste:
      - – Wood, paper products, leaves

? Food waste
  - ? Pre-consumer
  - ? Post-consumer

What can we compost?

? Cannot compost:
  - ? Glass, Plastic, Metal
  - ? Toxics
  - ? Bits and pieces of the above are troublesome

What can we compost?

? Estimate waste quantities
  - ? Start with information you already have
  - ? Compare to other institutions
  - ? Develop ranges of estimates

? Understand factors affecting compostable waste
  - ? Packaging
  - ? Service wear
  - ? Buying value-added products vs. in-house processing
  - ? Type of food (ex: Missoula vs. Butte)
  - ? Post-consumer waste handling

What can we compost?

? Conduct a Waste Audit (ideally)
  - ? Understand waste patterns
  - ? Need to sort garbage
    - ? At least one "typical" day
    - ? More samples give better results

What can we compost?

? Great opportunity to reduce kitchen waste
  - ? Switch to reusable, recyclable, and compostable materials
  - ? Buy in bulk
  - ? Buy recycled
  - ? Many examples!
    - ? Research pollution prevention ideas

What can we compost?

? What might you compost here?
  - ? Food wastes?
  - ? Other green wastes?
  - ? Wood waste?
  - ? Other "brown" wastes?

Where will we compost?

- On-campus
- Off-campus
  - University farm
  - Farm cooperator
  - Other available space

Where will we compost?

- Considerations:
  - Space requirement
  - Odor
  - Transportation
  - Technology
  - Cooperators
  - Project drivers

Where will we compost?

- Need space for:
  - Composting system
  - Maneuvering
  - Feedstock storage
  - Curing
  - Finished compost storage
  - Associated operations

Where will we compost?

- Remember:
  - Garbage stinks!
    - Food waste is garbage before it is composted
    - Perception is reality
  - Garbage is ugly!
    - Need visual controls

4. Design Project

- Location
- Choose technology
- Develop collection and transportation systems
- Develop O&M procedures
  - Identify responsible parties

Technology Options

- Need to consider:
  - Site issues
    - available space
    - neighbors
  - Materials to be composted
  - Labor
  - Technical complexity
  - Costs

Technology Options

? Example:
  ? Want on-campus, back-door composting
    ? Limited space
    ? Odors and aesthetics are important
  ? Have cooperation from campus infrastructure
  ? Want to provide education and research opportunities
  ? Want to extend campus recycling opportunities

? Good Choice:
  ? In-vessel system

Technology Options

? Example:
  ? Want to composting at a farm
    ? Neighbors used to farming activities
    ? Plenty of space
  ? Have good waste, manure, bedding
  ? Farm labor and equipment available
  ? Want low cost, low tech

? Good choice:
  ? outdoor turned windrows
  ? static piles

Collection and Transportation

? Food Wastes
  ? Pre-consumer (in the kitchen)
  ? Post-consumer (in the dining room)

? Collection and transportation is part of project design

Collection and Transportation

? Pre-consumer (in the kitchen)
  ? Separate compostables
    ? Special containers
    ? Training (easy)
  ? Collect containers for transport and/or processing
  ? Transport wastes daily
    ? Food wastes cannot sit around
    ? Need to haul and process right away

Collection and Transportation

? Post-consumer (in the dining room)
  ? Separate compostables
    ? Special containers, food grinder
    ? Training consumers (not so easy)
  ? Collect containers for transport and/or processing
  ? Transport wastes daily
    ? Food wastes cannot sit around
    ? Need to haul and process right away

Operations & Maintenance

? Identify all tasks required, start to finish
  ? Separation
  ? Collection and transportation
  ? Routine processing
  ? Periodic maintenance
  ? Bulking agent, curing, storage, end-use

? Assign all tasks to individuals

? Identify responsible parties

? O&M is part of project design

5. Permitting

- ? Food waste composting is a form of solid waste management!
- ? Montana DEQ regulates solid waste
- ? Permit could be required:
  - ? Contact DEQ Solid Waste Department (406) 444-4400

6. Costs and funding

- ? Costs
  - ? Up-Front Costs
    - ? Site preparation
    - ? Equipment
    - ? Staff time
    - ? Permitting
  - ? On-going Costs
    - ? Labor
    - ? Utilities
    - ? Maintenance

6. Costs and funding

- ? Funding
  - ? Investment
    - ? Cost savings
      - – Waste hauling and/or management
      - – Compost purchases
    - ? Marketing tool
    - ? Research and education tool
  - ? Grants
  - ? Consider project drivers

Things to Avoid

- ? Do not work outside of “the system”
- ? Do not rely on volunteers
- ? Do not rely on students
- ? Do not ignore potential complaints

- ? Learn from experience of others!

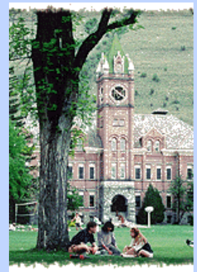
Starting a Food Waste Composting Project

- ? Questions?
- ? Discussion?

Food Waste Composting Demonstration Project

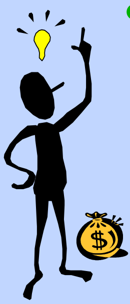
University of Montana
Dining Services

Food Waste Composting Demonstration Project



- University of Montana
  - Dining Services
  - Facility Services
- Composting food waste from main kitchens
  - Pre-consumer
  - Post-consumer
  - Wood waste from Lubrecht

How it got started

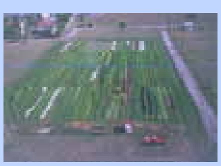


- Just like most "green" projects
  - A good idea
  - A motivated person
  - A bunch of research and hard work
  - A few false starts
  - Lots of perseverance and patience
  - The right people, energy, and timing
  - And MONEY !

The motivated person

- Mark LoParco
  - Director of Dining Services
- Also ~
  - Josh Slotnick
    - Garden City Harvest / PEAS
  - Josh Burnim, Josh Klaus
    - Recycling program intern
  - Byron Drake
    - Dining Services

The false start

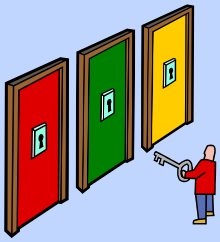


- Waste separation in campus kitchens
- Student volunteers
  - Food waste collection
  - Pile maintenance
- Outdoor windrow composting at PEAS farm

The new start

- Recycling goals
- Learned from mistakes
- Cooperative effort
  - Dining Services
  - Facility Services
    - Recycling program
  - Students
  - Faculty
  - Outside help
- Comprehensive effort

Technology selection



- On-campus
  - In-Vessel
- User friendly
- Size
- Track record
- Cost

Earth Tub by GMT

Commercial Duty Compost System

- Designed for on-site composting of food-wastes
- Fully enclosed composting vessel featuring:
  - power mixing
  - compost aeration
  - biofiltration of all process air
- Ideal for composting at schools, universitie restaurants, hospitals and supermarkets

(http://www.gmt-organic.com/et-info.html)

Loading

- Start cycle by filling tub half full with your carbon source
- Load daily with your green waste until the tub is full

Mixing

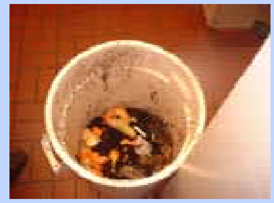
- You use the motorized auger to mix the contents each time you add green waste

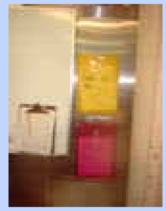
Unloading

- After several weeks of active composting, you open the discharge door and use the auger to push the compost out the door
- Compost should be cured for another 30 days

University of Montana’s Installation

- Two tubs located behind kitchens
- 210 lbs/day food waste
- Wood shavings used for bulking agent
- Fenced for protection



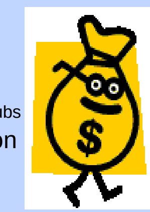


The numbers

- Food Waste Generated
  - 210 lbs/day pre-consumer
- Two Earth Tubs
  - Load one daily for a week
  - Alternate tubs
  - 21-day cycle in tub
- Predicted Compost Yield
  - 3 cubic yards per tub per cycle

Initial Costs

- Earth Tubs
  - $16,500 for 2 tubs
- Site Preparation
  - $21,000
- Repairs
  - $1,200
- **Total**
  - $40,000



- University Funds
  - Dining Services
  - Facility Services
  - Auxiliary Admin.
- EPA Grant
  - $5,000 toward tubs
  - $4,700 for outreach

Lessons Learned

- Enthusiasm is important, but not enough
  - Composting is waste management and must be treated as such
  - Faculty and students have other responsibilities
  - Not all affected people will be supportive
- Plan to spend more money than you expect
  - Plan for problems
- Plan to spend more time than you expect
  - New things always take time

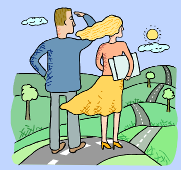
Lessons Learned

- Sell the idea up front to the campus community and building residents
  - It really helps when problems occur
- Have your bases covered
  - Assign responsibility for all functions
  - Provide training and oversight
  - Have a plan for problems

Lessons Learned

- Carefully follow all set-up instruction
  - Cutting corners can lead to big problems
- Have a compost expert monitor the system for the initial run
- Expect problems
- Expect complaints

Future Plans



- Planned Events
  - Demonstration days
  - Workshops for other interested universities and institutions
  - Campus classes and projects
  - Web site
  - Documentation
- Large scale campus-community composting

Food Waste Composting Demonstration Project

at the
University of Montana

Articles Printed in The Kaiman and The Missoulian

‘Earth tubs’ yield useful compost

Chelsea DeWeese
Montana Kaimin

Ever wonder what happens to the meal-plan money you don’t spend by the end of the week?

University of Montana Dining Services goes shopping with it, and a few of the food service’s most recent purchases, two “earth tubs,” are almost on line despite some lurches along the way.

The massive plastic bins are self-contained recycling machines. When they are up-and-running — after what has been a nearly four-month manufacturer-caused delay— Dining Services employees will use the tubs to mix food scraps and coffee grounds with wood shavings to create nutrient-rich compost for landscaping projects around campus.

“Instead of wasting, you’re essentially closing the energy circle,” said Joshua Klaus, a second-year graduate student in the Environmental Studies program who helped bring the earth tubs to their current location in a fenced-off area behind the Lommasson Center.

Dining Services Director Mark LoParco said he hopes the tubs will be making earth within a couple of weeks, after facility employees do some finishing technical touches on the machines.

After “biofilters” are installed, food wastes can be dumped into the machines, which in-turn will essentially self-monitor heat and humidity. Each blue vat is about 4 feet tall and looks as if 10 people could fit inside it. Attached to the inside of each tub’s rotating cover is a large auger that will churn the waste mixture as it breaks down. Panel doors allow access to the inside of each tub so compost can be easily removed.

“From a composting standpoint, they should be clean and odor-free,” said Byron Drake, the assistant director for residential dining at the Food Zoo.

He and LoParco played an integral role in the reintroduction of a composting program on campus.

About four years ago, Dining Services had a composting program that didn’t work out because of transportation issues, LoParco said. LoParco, a member of the Recycling Oversight Committee on campus, suggested giving it another shot at a meeting last year, and a student intern discovered the earth tubs.

After logistics were worked out, and the Montana Department of Environmental Quality secured a $5,000 grant for the project, Dining Services decided to purchase the two tubs for $16,000, LoParco said.

He said the decision was based on many factors, one being a continually growing trend in environmental consciousness among students.

LoParco said University Dining Services is purchasing a new dishwasher that will be far more energy-efficient, and a separate “pulverizing machine” that will grind and compact leftovers at the Food Zoo for the earth tubs.

He said Dining Services and the university community should be leaders in socially and environmentally friendly practices such as conservation, composting and recycling.

According to statistics from campus facilities, UM is getting there.

In a press release issued by Carey Lemer, the recycling coordinator on campus, UM is close to reaching its goal of reducing waste by 25 percent.

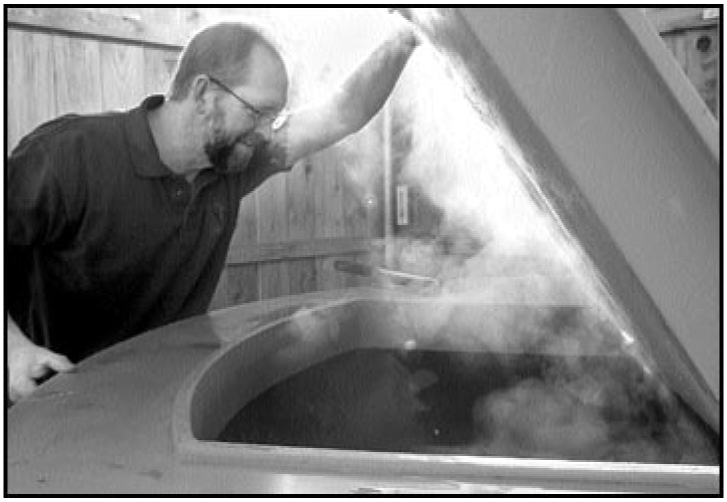
According to statistics, the amount of cardboard recycled on campus leapt by 207 percent this year, with mixed paper increasing by 204 percent. The amount of newspaper recycled on campus increased by nearly 66 percent, and aluminum followed with an increase of 62 percent.

Students are encouraged to drop by any of the 75 recycling stations tucked in and around buildings throughout campus. Faculty and staff members can sign up for a payroll deduction plan to help fund the recycling program.

For more information visit www.facs.umt.edu/ facilities/recycle/index.htm

Resourceful waste

By BETSY COHEN of the Missoulian



Byron Drake checks one of the two tubs behind the food services building on the University of Montana campus that are being used to make compost from food scraps that previously were thrown away.
Photo by TIM THOMPSON/Missoulian

Collaboration fuels on-campus composting at UM

They might look like hot tubs, but the two giant bins recently planted outside the University of Montana's Lommasson Center are called Earth Tubs.

What they do is compost, and at UM they have been assigned to create soil amendment from the 42,000 pounds of food waste generated by Dining Services each year.

"This is a project we have been hoping to do for a long time, and we are excited about the opportunity to do this," said Byron Drake, UM's assistant director for residential dining.

Although the tubs arrived a few weeks ago, the effort to bring a composting program began well over a year ago when the campus recycling committee broached the topic.

"We got pretty excited about it but it took some time to figure out where we would put such a project and where we would get the equipment," said Neva Hassanein, an assistant professor in environmental studies.

Collaboration between Hassanein's department, Dining Services, UM forestry programs, Louisiana-Pacific Corp. and a grant from the state Department of Environmental Quality pulled the project together and pushed the idea into reality.

Earth Tubs were chosen for the job because they are easy to use, have low maintenance and use wood chips, not worms, to transform food scraps into a soil product, said Denise DeLuca, a Missoula environmental consultant who helped research the equipment.

Although faculty, students and Dining Services staff are just learning how to use the tubs, they expect it will take about 90 days to turn the vegetable waste into a nutrient-rich byproduct that can be used for campus landscaping.

The tubs will compost all the pre-consumer waste that is generated in UM's kitchens, which amounts to roughly 120 pounds per day, DeLuca said. If her estimations hold true, over the course of a year, the tubs will transform roughly 42,000 pounds of waste into 26,250 pounds of compost each year.

Once everything starts to run smoothly, project participants will shift their attention to composting post-consumer waste, DeLuca said.

That goal may be trickier, though not impossible to achieve, because it involves educating the campus community on what can and can't be composted, and developing a system people find easy to use.

When the current composting system becomes routine business at UM, it will hopefully become a model for other state institutions and campuses, Hassanein said.

Not only will students be involved in the composting project, learning everything from its biochemistry to how food-waste recycling is tied between land and community, but the project also will demonstrate that composting is a viable thing to do.

"This is a very physical manifestation of our increasing effort to make this campus more green," she said. "Because the campus can be a model and really illustrate what is possible - which is what universities are all about - this is an ideal project.

"It's not just talking the talk, but walking the walk and putting ideas into practice."

Drake said he doesn't expect the tubs to necessarily save money for UM, although they could eventually.

"For us, this is more of a social responsibility," he said. "Keeping this stuff out of the landfill is the right thing to do."

Reporter Betsy Cohen can be reached at 523-5253 or at bcohen@missoulian.com